

INCENTIVE PERFORMANCE
RELATED PAY AND
PRODUCTIVITY

by

Nadia Klos

A thesis submitted in partial fulfillment of
the requirements for the degree of

Master of Arts in Economics

National University "Kyiv-Mohyla Academy"
Economics Education and Research Consortium
Master's Program in Economics

2006

Approved by _____
Ms. Serhiy Korablin (Head of the State Examination Committee)

Program Authorized
to Offer Degree _____ Master's Program in Economics, NaUKMA

Date: May 22, 2006

National University “Kyiv-Mohyla Academy”
Economics Education and Research Consortium
Master’s Program in Economics

Abstract

INCENTIVE PERFORMANCE
RELATED PAY AND
PRODUCTIVITY

by Nadia Klos

Head of the State Examination Committee: Mr. Serhiy Korablin,
Economist, National Bank of Ukraine

This paper is an attempt to study influence of the use of performance related incentive pay applications on company’s performance in terms of productivity. The subject of interest are: expected bonus share in full wage, introduction of monetary incentive performance related pay scheme, not operating any monetary incentive performance related pay scheme, profit sharing system and level of wage determination.

An annual sample of ULFS enterprise level panel questionnaire for 6 time periods of 1993 - 2003 will be used. For estimation RE model was found to be the most appropriate.

TABLE OF CONTENTS

| | |
|---|-----|
| LIST OF FIGURES..... | ii |
| ACKNOWLEDGMENTS | iii |
| GLOSSARY..... | iv |
| INTRODUCTION..... | 1 |
| LITERATURE REVIEW | 4 |
| 2.1 Theoretical Background | 4 |
| 2.2 Empirical Findings | 8 |
| METHODOLOGY..... | 11 |
| 3.1 Background Models | 11 |
| 3.2 Model for Labor Productivity Estimation | 12 |
| DATA DESCRIPTION | 17 |
| EMPIRICAL FINDINGS..... | 29 |
| CONCLUSIONS..... | 32 |
| BIBLIOGRAPHY | 33 |

LIST OF FIGURES

| <i>Figure</i> | <i>Page</i> |
|--|-------------|
| Graph 1 P-A theory | 7 |
| Graph 2 Crowding out theory | 7 |
| Graph 3 Labor productivity over time..... | 18 |
| Graph 4 State ownership, time | 18 |
| Graph 5 Shares belonging to workers, time..... | 19 |
| Graph 6 New organizational structure carried out during the previous year, time..... | 19 |
| Graph 7 Size of an enterprise, time | 20 |
| Graph 8 Expected bonus share in full wage, time | 20 |
| Graph 9 Introduction of performance related incentive pay, time | 21 |
| Graph 10 Operating profit sharing system, time | 21 |
| Graph 11 No performance related incentive pay scheme used, time | 22 |
| Graph 12 Skilled workers that resigned over the last year, time | 23 |
| Graph 13 Personnel excess, time | 23 |
| Graph 14 Individual level of wage determination, time | 24 |
| Graph 15 Brigade level of wage determination, time | 24 |
| Graph 16 New technology introduced, time | 25 |
| Graph 17 Fixed assets 1000 UAH, for the current period, time..... | 25 |
| Graph 18 Capacity utilization %, time | 26 |
| Graph 19 Share of blue-collar workers %, time..... | 26 |
| Graph 20 Share of exports in total sales %, time..... | 27 |
| Graph 21 Competitive environment, time | 27 |
| Graph 22 Share of workers-members of labor unions %, time..... | 28 |
| Graph 23 No subsidies, time | 28 |

ACKNOWLEDGMENTS

The author wishes to thank Tom Coupe, Oleksandr Lytvyn, Helen Volska and Igor Klos for recommendations, help and inspiration provided for this work accomplishment

GLOSSARY

Briefing group. Over 25% of time dedicated to communication with workers is left for employees' questions and propositions

Problem-solving group. Groups for production problems solving, involving at least 60% of non-managerial employees

Representative participation. Type of communication between management and employees, when negotiation part is limited

Bonus. An additional payment (or other remuneration) to employees as a means of increasing output:

Chapter 1

INTRODUCTION

Nowadays introducing innovative Human Resource Management (HRM) techniques is a widespread practice among Western countries. All kinds of incentive pay are claimed to be an effective tool to increase employees' motivation to work hard and thus, to increase the productivity of an enterprise. Ukraine, being a country in transition and having practiced prizing employees with premiums and bonuses during the Soviet period, is not an exception, (Chemekov (2002)).

Scrutinizing theoretical literature on incentives, one can find out that, on the one hand, according to classical principal-agent theory, given the rationality assumption, incentive pay positively affects employees' effort. And part of empirical papers indeed support the theory (Kruse (1992), Ichniowski and Shaw (2003)). On the other hand a newer "crowding out" theory, which drops the assumption of agent's pure monetary motivation, supports the opposite statement: imposition of an incentive pay, especially of a relatively small size, may in fact decrease employees' motivation to perform up to abilities. The reason for this is the elimination of intrinsic motivation, as introduction of some obligatory amount of output to produce is often considered by employees as a signal of distrust. And there were numerous research works done, that supported the argument, such as Titmuss (1970), Rothe(1970), Gneezy and Rustichini (2000), McNabb and Whitfield (2003).

Though, various research works have been done on studying the relationship between incentive pay and productivity in developed countries, only few studies have been handled on incentive pay and productivity in transition economies, and even less for Ukraine, Buck (2003). He used structural equation modeling to

find out relationship between corporate governance, HRM strategies and corporate performance, using cross section 1999 Ukrainian Labor Force Survey (ULFS) data set. He found out that firms, not using modern HRM techniques perform worse. Still, the main question of this paper remains untouched.

The goal of this paper will be to find out how expected bonus share in the full wage, imposition of incentive performance related pay schemes, level of salary distribution and using plain fixed salary influences labor productivity in Ukraine.

This issue is interesting subject for research because it has huge practical application opportunities. As based on the results, firms will be able to plan their motivation policies taking into account returns on labor productivity. This paper will show concrete percentage change in labor productivity from application of mentioned HRM tools.

In addition, this paper will help to shed some light on interesting tendency which has been taken place in Ukraine during the last ten years: bonus share in the full wage has been constantly decreasing since 1993 from 36% to 23%. Decreasing bonus share in wage can be explained by its negative relation with productivity, and then the crowding out effect has the economy-wide scale. Still if there is a positive relationship between bonus share in the full wage, some more pragmatic explanations may be valid. So the main question that has to be answered is the sign of relationship between labor productivity and expected bonus share in full wage.

The model which will help to answer the question will be based on the empirical model, created by McNabb and Whitfield (2003), where they studied the relationship between individual and group-based incentive pay and corporate performance. Labor productivity, measured as a ratio of sales and company size, will depend on five groups of variables according to Bartelsman and Doms

(2000) : Ownership, Human capital quality, Technology level, International exposure, Environment and regulation.

The analysis will cover a set of enterprise level data of 92 firms for different years of the overall period of 1994-2004, totaling to 552 observations, gathered in ULFS questionnaire (Questionnaire for Labor Flexibility Study at Industrial Enterprises). The ULFS report provides all data necessary to estimate the model.

This research will have several advantages compared to the previous studies: the thesis will explain relationship between incentive pay (premiums, bonuses) and productivity in a quickly changing transition environment of Ukraine, thus in the end it will be clear – which of two effects dominates in this country. In addition, a panel data will be used in this research, which was not done before in the previous studies for Ukraine. It will make the results more reliable and will help to overcome a number of problems, such as omitted variables and heteroscedasticity.

LITERATURE REVIEW

Literature dedicated to the issue of incentive pay and performance could be structured in several dimensions. First of all, all the research work can be split into theoretical and empirical studies. Theoretical studies primarily cover the mainstream principal-agent theory and its' variations, and the opposite theory, that explains so called crowding out/crowding in effect (clarification on terminology is provided further). There are also numerous empirical studies that support either classical principal-agent or crowding out/crowding in theory. Empirical studies vary depending on the type of empirics carried out: there are plenty of experiments, dedicated to the issue as well as attempts to estimate some models or just surveys with minor analysis of the data. The other dimension, the related empirical literature can be structured in is the level of data study. While theory that supports the issue was designed for individual level of data, empirical papers consider one of at least three data levels: individual level data, group level or enterprise level data.

2.1 Theoretical Background

Classical principal-agent problem considers two sides, employees and employers, to be the participants of economic interactions. Employers are principals (they design contracts and are in relative informational disadvantage – they do not observe the level of effort of the employee) and employees are agents (they have informational advantage). The model is based on several assumptions: principals are risk neutral or risk averse, agents are risk-averse or risk neutral, and all parties are rational: material incentives are necessary and sufficient to motivate employees work, furthermore, the higher sum of monetary compensation causes higher effort (if impossible to cheat). Output of an agent is a stochastic function

of an effort, but the effort of an agent is not observable function and the utility functions of the participants are of von Neumann-Morgenstern type. The sequence of actions looks the following way. Stage 1: Employers create a contract having or not the condition of awarding premiums; stage 2: Employees sign or not; stage 3: Employees decide on quantity and quality of work they want to; stage 4: Employees handle a work; stage 5: Employer evaluates the results; stage 6: Employer pays for work provided including premiums. The pay-off scheme for the interaction is provided in the Appendix 10.

According to this Principal-Agent theory¹, performance related pay is more preferable than plain fixed pay, because it provides incentives and attracts workers, whose productivity is higher than average, thus they believe they can earn more within performance related scheme. Indeed, in case, where our workers are risk neutral, residual claimant scheme is optimal for remuneration.

Thus, if $pay = a + \beta q$,

where q is employees' performance, which depends on effort e and error term v ($q = e + v$), thus effort is proxied by performance with coefficient 1. a is a fixed part of the salary, and β is a performance related part of the salary. $C(e)$ is a cost of effort as it creates disutility for an agent, which is increasing convex function of effort. Agent maximizes his utility:

$$\max_e E(a + \beta q - C(e))$$

$$\max_e E(a + \beta(e + v) - C(e))$$

$$\max_e a + \beta(e + v) - C(e)$$

$$\text{FOC: } C'(e) = \beta \rightarrow \partial e / \partial \beta > 0$$

¹ All basics of PA theory provided here are taken from Tom Coupe Labor Economics I class notes.

It shows that the larger a variable part of the pay, β is, the higher effort will be provided by agent to do the work, and thus, the more productive worker will be. This result can be transferred to the enterprise level – so the more productive enterprise will be.

In addition, as mentioned above, performance related schemes help to deal with adverse selection in the following way.

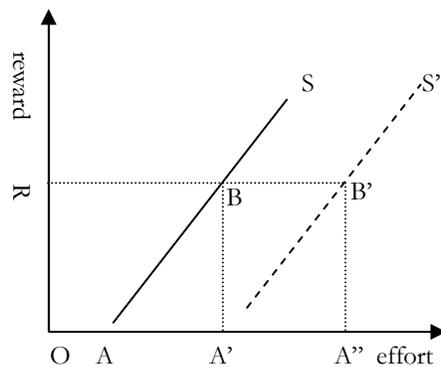
Having two firms, one paying $pay = a + q_i$ to its employees and the other $pay = a' + \beta q_i$, where $\beta < 1$ and $a < a'$. Thus we take a case with employee residual claimant in the first case and employee whose wage is not purely depend on sole output, the fixed part is higher, while variable part depends on β . If both pay schemes provide equal pay under condition of optimal output ($q_i = q^*$), low productive workers, whose $q_i < q^*$ will chose a low performance related wage share firm, and high productive workers, whose $q_i > q^*$, will choose high performance related wage share firm.

Despite simplicity, this model has several shortcomings or implicit assumptions, which may make it invalid. First, there is no negotiation process issued to wage contract possible between agent and principal. Second, there is perfect commitment assumption from agent and principal. Third, pay is a linear function of output. Forth, there is no measurement cost. Fifth, agent is committed to do only one type of job. Sixth – principal knows the cost function of an agent. Seventh – perfect information on relation between effort and productivity. Eight – no wealth constraint to the agent.

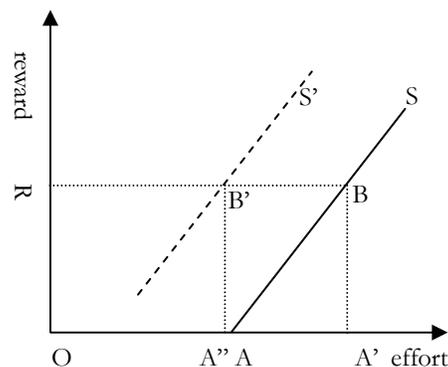
Still some economists and psychologists find the rationality assumption in this theory too strong, and thus another, crowding out theory was developed in 1970's after the famous 'Titmuss' experiment at blood donation center, when imposition of monetary remuneration to blood donors instead of increasing

blood donations, slightly decreased them. Thirty years later, Frey and Jegen (2000) have studied the issue close to the problem discussed in this paper: they considered motivation crowding effect, which is reputed to be “one of the most important abnormalities in economics”, and takes place, when monetary incentive payments decrease workers’ performance via destroying intrinsic motivation. He describes three situations of external monetary intervention influence on agent’s motivation. First, according to standard economic principal-agent theory, monetary rewards or commands generate disciplining effect on agents and increase productivity, as well as intrinsic motivation increase does. Second, monetary rewards commands may decrease intrinsic motivation and thus, decrease productivity. Third, both effects are usually present, thus the actual effect depends on relative size of each of them. Graphically existence of these effects can be outlined as follows:

Graph 1 P-A theory



Graph 2 Crowding out theory



Source: Frey and Jegen (2000)

Both graphs show the classical supply curve, on the relationship between reward promised to employees and effort, put into work. In classical principal-agent case when promised some minimal remuneration agent works with an effort A . With reward increase to the level of R , agents start working with effort A' . Later, in case of incentive pay introduction, the supply curve will shift to the right, and

now agent will supply A'' of effort. In case when crowding out effect prevails, inducing incentive pay results in the supply curve shift leftwards and agents will prefer to supply only A'' level of effort, i.e. less than before.

2.2 Empirical Findings

Both theories have a rich empirical support in developed and developing countries via experiments, surveys and model estimations. As already mentioned, first experiment to be carried out on the issue, supporting crowding out theory, was carried out by Titmuss (1970). Even though the evidence was rather weak, the research piece caused active discussions in the economists' and psychologists' world.

During the same year Rothe (1970) has carried out an experiment that studied US welders' performance with and without an incentive scheme. He found out that right after the removal of an incentive scheme welders performance dropped dramatically and then slowly moved back to the previous level. Which proves, that incentive pay has an influence on productivity only once, upon imposition or removal, still there is no continuous effect.

In 2000 Gneezy and Rustichini organized another experiment. The experiment involved charity box gathering by children in Israel. Two groups of children were formed: first group was paid for work and its performance increased along with the amount of money given them for work fulfilled; second group was not paid at all, but gathered a bigger amount of donations, than the first group.

Some models and surveys, supporting one of two approaches were run as well.

Influence of profit sharing schemes (a type of progressive incentive pay) on productivity in the United States was studied by Kruse (1992). The results show that profit sharing introduction leads to 2.8-3.5% productivity increase.

Nevertheless this increase can be explained also by introduction of other advanced HRM techniques or by management team renewal.

There were also several other studies that covered incentive pay and productivity study in developed countries. Bayo-Moriones and Huerta-Arribas (2002) used a sample of 719 observations on Spanish producers to investigate the relationship between incentive pay application and organization performance. Study showed that incentive pay schemes are usually applied within firms of a smaller size, with expected employment increase in the nearest future, high degree of automation, personality being the key factor during employment process, employee participative behavior promotion.

Ichniowski and Shaw (2003) talked about using econometrics for estimating effectiveness of innovating HRM practices in the US steel industry. The result of the research showed that applying incentive pay and team techniques results in annual additional \$1.4 million output for an average steel mill. Output varies across steel lines and is bigger in those where introducing HRM technique is relatively cheap.

In McNabb's and Whitfield's work (2003) relationship between performance (evaluation in a range "below average-above average") and incentive pay variables (whether performance-related pay is being in use, and whether incentive schemes are individual or group performance related.) A sample of 2191 British enterprises employing over 10 employees for the year 1998 was used. They come up with a conclusion that relationship between workers performance and incentive scheme application is not definitely positive. Meaning negative and significant at 5% level relationship assuming interactions between principal are impossible, insignificant once interactions are possible, still in combination with financial participation schemes of innovative work practices switched to positive and significant. An ordered probit model was run to estimate the coefficients.

Incentive pay in transition economy was studied by Buck, et al. (2003). They considered three types of HRM, i.e. high commitment HRM strategy, low commitment HRM strategy, and cost-cutting HRM strategy, and identified the most common traits of each of them. Data analysis showed that firms who chose high commitment strategy are usually owned by insiders, are larger and older than others, they are usually expanding their employment, and support employees with additional trainings, innovative incentive schemes, whereas low commitment firms are owned by external owners as well as cost-cutting firms are. LCF can be characterized by less risk of lay-offs and direct benefits. Moreover, cost-cutting firms are less productive and are rather big. As we see the emphasis of this work is put on the reverse relationship between key characteristics of a firm and application of payroll system. In addition only one period for the year 1999 data set was used.

To summarize, according to the classical principal-agent model, incentive pay increases individual effort, while crowding out theory stated that incentive pay may decrease agent's intrinsic motivation and thus, performance. Empirical evidence shows that experiments are more likely to prove crowding out theory; while regressions run show that classical principal agent theory has also proved for existence. Some empirical papers also find an inverse relationship between firm performance and incentive pay.

METHODOLOGY

3.1 Background Models

Model for estimation labor productivity will be based on work of Bartelsman and Doms (2000) in which they found out that labor productivity depends on 5 groups of variables that determine Type of Ownership, Quality of Human Capital, Technological Level of an Enterprise, International Exposure of an Enterprise and Regulating Environment.

McNabb's and Whitfield's (2003) work will be used as a basis for proxy variables suitable for each group of variables, in addition new variables will be introduced. In their research McNabb and Whitfield (2003) used the following model for corporate performance evaluation.

$$Y = f(I, P, S, U, T, M, O, D)$$

Y – Corporate performance (Far above average, Above average, Average, Below average, Far below average)

I – Incentive pay variable (I_a – Any performance related schemes, I_b – Individual or group based)

P – Employee participation scheme (Problem-solving groups, Briefing groups, Representative participation)

S – Size of an establishment (Number of employees)

U – Participation in the Labor Union (Managers find union to be the purpose for collective bargaining)

T – Technology variable (Proportion of labor at routine unskilled work)

M – Nature of product market (Whether company takes over 25% market share)

O – Age of an establishment

D – Demand for company’s mainstream product (whether market has grown over the last 12 months).

3.2 Model for Labor Productivity Estimation

Thus, the function of labor productivity has the following shape:

$Y = f(\text{State ownership, Reorganization implemented, Belong to workers, (Size of an enterprise, Expected bonus share in full wage, Introduction of monetary incentive scheme, Profit sharing scheme application, No performance related scheme application, Skilled personnel resign, Personnel excess, Wage determinant), (New technology introduced, Fixed assets, Capacity utilization, Share of blue-collar workers), (Share of sales exported), (Competitive environment, Share unionized, No subsidies)})$

Labor productivity will be measured as a natural logarithm of ratio of Sales, in 1000 UAH, and size of an enterprise, measured in total number of employees. Thus, a percent change of productivity will be explained by independent variables.

3.2.1 The Ownership set of variables

State owned – A dummy variable, which takes a value 1 if enterprise is of state or state municipal type of ownership. It is expected that state owned enterprises are less productive, as mentioned in Bartelsman and Doms (2000) study, due to more poor flexibility and lack of managerial incentives for outstanding performance.

Belong to workers – percentage of shares, belonging to employees, 0 – if not a CJSC. Should have a direct relationship with productivity, as workers will try to contribute to the enterprise as a whole, when owning it, Buck (2003)

Reorganization – a dummy variable, which takes a value 1 if enterprise was reorganized over the last period. As main purpose of reorganizations is increase in efficiency, we expect that reorganization has a positive effect on labor productivity. Unfortunately lagged variables will be impossible to check due to unbalanced data set.

3.2.2 Human Capital Quality set of variables

Size of an enterprise – natural logarithm of number of employees. The effect of this variable is ambiguous, because, on the one hand, bigger enterprises have an opportunity for economy of scale; on the other hand they are less flexible to adjust to changing environment this variable was used in number of research pieces, for instance McNabb's and Whitfield (2003).

Expected bonus share in full wage, %. According to classical PA theory, more monetary incentives should increase effort, and thus, productivity.

Introduction of monetary incentive scheme (bonuses) – a dummy variable taking value of 1, if a monetary incentive scheme was introduced during the last year, a direct relationship is expected. We make the hypothesis that influence of this variable on labor productivity will be resembling performance related monetary incentive schemes removal influence in Rothe (1970) but with the positive sign: labor productivity will grow dramatically after the imposition of bonus remuneration scheme and then decrease over time. Unfortunately lagged variables will be impossible to check due to unbalanced data set.

Profit sharing scheme, dummy variable taking value 1 if enterprise operates profit sharing. According to Buck (2003) should have positive relationship with productivity because workers start identifying themselves with an enterprise, and thus perform better

No bonus – dummy variable taking value one if enterprise does not operate monetary incentive schemes except for plain wage. The expected sign of this relationship is minus

Skilled personnel resigned – natural logarithm of skilled workers that resigned over the last year. Should have a negative sign because skilled workforce leaving on their own withdraws some talent and skills from the total performance before new hired personnel catches up with production process

Personnel excess – dummy variable, which takes value of 1, if more output can be produced with the same quantity of workers. Should have a negative relationship with productivity, as in this case enterprises does not use completely it's human resource factor.

Wage determinant – a dummy variable, for each of the major factors that determine wage at the enterprise (individual performance, group performance, which should have a positive relationship with productivity) McNabb and Whitfield (2003), Buck (2003).

3.2.3 Technology Level set of variables

New technology introduced – a dummy variable, which takes the value one, if a new technology was introduced over the last year. This variable should have a direct relationship with productivity, as it proves higher technological equipment, what was found by McNabb and Whitfield (2003) Unfortunately lagged variables will be impossible to check due to unbalanced data set.

Fixed assets – natural logarithm of average value of fixed assets in 1000 UAH (period under study in the questionnaire). Should increase productivity.

Capacity utilization, % - weighted average capacity utilization over the period, should have direct relationship with labor productivity.

Share of blue collar workers in the total workforce, % - this variable tells about the part of unskilled work that could have been automatized, McNabb and Whitfield (2003). This variable should have a negative relationship with labor productivity.

3.2.4 International Exposure set of variables

Share of sales exported, % - this is rather straightforward variable, which should have a direct relationship with productivity, as exports open new markets for an enterprise, allowing them to produce more.

3.2.5 Environment and Regulation set of variables

Variables, characterizing environment and regulation could be presented in the following set:

Competitive environment – a dummy variable, which takes the value 0 if enterprise is in any type of monopolistic position and one otherwise. This variable should have a positive relationship with productivity as competitive environment forces firms to seek any available sources of productivity as it was found in McNabb and Whitfield (2003).

Share unionized, % - variable, that shows the share of employees that belong to the labor union. This variable should be related negatively with labor productivity, due to additional inefficient requirements set by labor unions, McNabb and Whitfield (2003), Bartelsman and Doms (2000).

No Subsidies – a dummy variable, which takes value one if an enterprise was not subsidized over the period. It should have positive relation on productivity as enterprises, which were not subsidized, have more motivation to perform better. Unfortunately, reverse causality is possible with this variable

In addition, there were three groups of control dummy variables introduced, which stand for time, geographical location and industry. Time dummies are dummies for each year. Regional location dummies indicate whether enterprise belongs to Kyiv, Kyiv oblast, Lviv, Ternopil, Mykolayiv, Kharkiv or Donetsk: enterprises of these cities only are represented in this sample. Industry dummy was created according to Derzhcomstat industry classification: Building industry, Food industry, Metallurgy, Chemical and Petroleum industry, Printing and publishing, Light industry, Energy, Machine building and others.

First, pooled OLS model will be run and tested for Multicollinearity, Heteroskedasticity, Endogeneity, Omitted variables. As data is unbalanced (time intervals are different) we assume there is no autocorrelation. In case of some of these problems arise, the model will be tested for better fit: Pooled OLS vs Random effect with the help of Breush-Pagan test, Pooled OLS vs Fixed effect with the help of F-test, Fixed effect model vs. Random effect model with the help of Hausman test.

Chapter 4

DATA DESCRIPTION

A panel data set of ULFS report will be used to carry out this research. The year periods covered will be: 1993-1994, 1994-1995, 1997-1998, 1999-2000, 2000-2001, 2002-2003. There were 94 firms, observed during this period, thus the number of observations will total to 552.

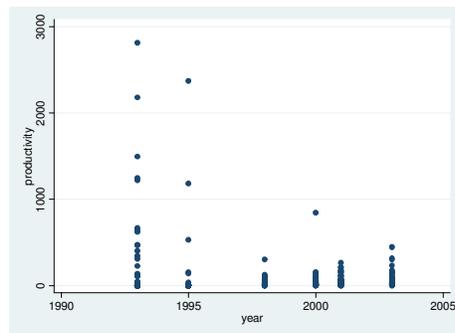
Table 1 Data Summary

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|--------|----------|-----------|----------|----------|
| Productivity | 552 | 61.52949 | 224.7925 | 0.022069 | 2812.5 |
| Natural logarithm of productivity | 552 | 2.148024 | 2.172637 | -3.81358 | 7.941829 |
| State owned | 552 | 0.222826 | 0.41652 | 0 | 1 |
| Share that belongs to workers | 552 | 23.98551 | 34.56244 | 0 | 100 |
| New organization structure over last year | 552 | 0.36413 | 0.481622 | 0 | 1 |
| Logarithm of size | 552 | 6.227456 | 1.326598 | 2.197225 | 9.508146 |
| Total number of employees | 552 | 1201.942 | 1988.357 | 9 | 13469 |
| Expected bonus share in the full wage | 552 | 28.59058 | 20.06068 | 0 | 100 |
| Introduction of bonus system over last year | 552 | 0.108696 | 0.311539 | 0 | 1 |
| Profitsharing system | 551 | 0.406534 | 0.491633 | 0 | 1 |
| Fixed wage remuneration system | 552 | 0.105073 | 0.306925 | 0 | 1 |
| Logarithm of skilled workers resigned | 524 | 3.137728 | 1.397778 | 0 | 6.871091 |
| Skilled workers resigned | 552 | 53.89855 | 95.72712 | 0 | 964 |
| Same output is possible with less workers | 552 | 0.369565 | 0.483125 | 0 | 1 |
| Individual level wage determination | 552 | 0.166667 | 0.373016 | 0 | 1 |
| Brigade level wage determination | 552 | 0.101449 | 0.302197 | 0 | 1 |
| New technology introduced over last year | 552 | 0.429348 | 0.495432 | 0 | 1 |
| Logarithm of fixed assets | 552 | 8.845363 | 2.187038 | 2.302585 | 13.61942 |
| Fixed assets | 552 | 42098.43 | 96252.52 | 10 | 821940 |
| Capacity utilization | 552 | 56.6875 | 28.8571 | 0 | 100 |
| Share of blue collar workers | 552 | 0.39639 | 0.327617 | 0 | 0.991758 |
| Share of sales exported | 552 | 13.26449 | 22.29758 | 0 | 100 |
| Share of personnel in labor union | 552 | 0.835145 | 0.371386 | 0 | 1 |
| Competitive environment | 546 | 89.78755 | 26.06426 | 0 | 100 |
| Enterprise does not receive subsidies | 548.00 | 0.95 | 0.23 | 0.00 | 1.00 |

Productivity variable was received as a ratio of Sales in the current period in thousands UAH's to the Total number of employees in the current period. The first two periods turned out to be really unproductive, but this was primarily due

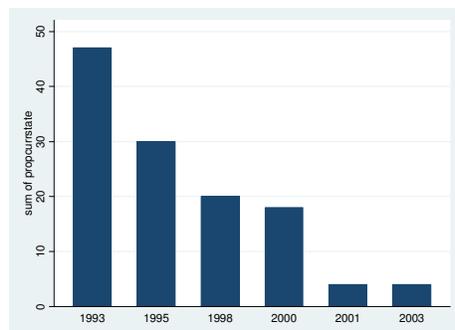
to hyperinflation. The other interesting fact about the productivity variable was that some extremely overproductive enterprises were present during the first two periods. This could be due to poor data entry (too many zeros in coupon sums) or to captured opportunities by a couple of enterprises being able to purchase cheap resources. We see that this variable changes from 22 UAHs per one employee to almost 3 million UAHs per one employee, averaging to 61 500 UAHs of sales per one employee. For the model natural logarithm of this variable will be used.

Graph 3 Labor productivity over time



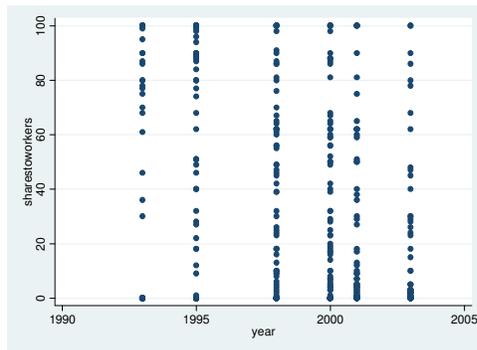
State owned dummy variable, received from a form of ownership question in the survey, state owned and municipal enterprises were taken into account all others were replaced with zeros. Data shows that on average 22% of firms happened to be in this category each year. And share of state owned enterprises constantly decreases.

Graph 4 State ownership, time



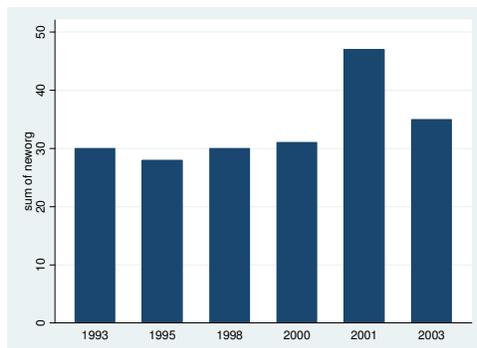
Shares, belonging to workers is a straight forward variable from ULFS report, in case when enterprise was not CJSC missing values were replaced with zeros. This variable varies from zero to one hundred, averaging to 23%. Looking at this variable over time, the most commonly insider ownership was used in late 1990's and dropped by nowadays.

Graph 5 Shares belonging to workers, time



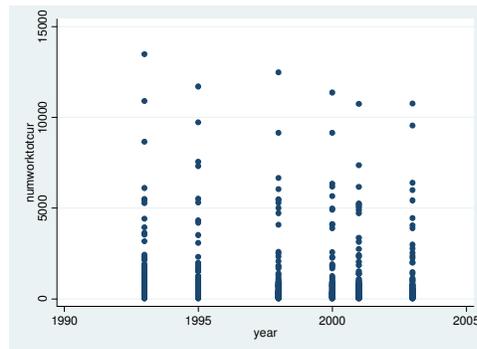
New organizational structure carried out during the previous year is a straightforward dummy variable from a survey. Over the period under consideration on average about 36% of questioned firms carried out reorganization each year.

Graph 6 New organizational structure carried out during the previous year, time



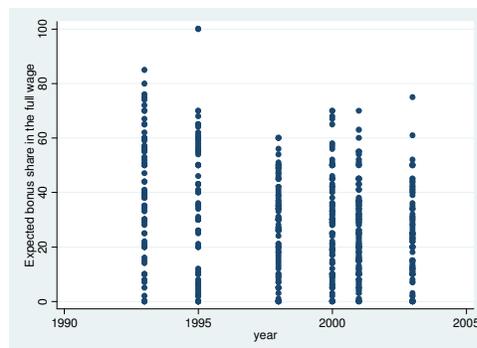
Size of an Enterprise is again a straightforward variable which shows the total number of firm employees during the current period. On average, firms questioned employed 1200 people, starting with 9 and ending with almost 13500. There is weak evidence toward slight average enterprise size decrease over time. For the model natural logarithm of this variable will be used.

Graph 7 Size of an enterprise, time



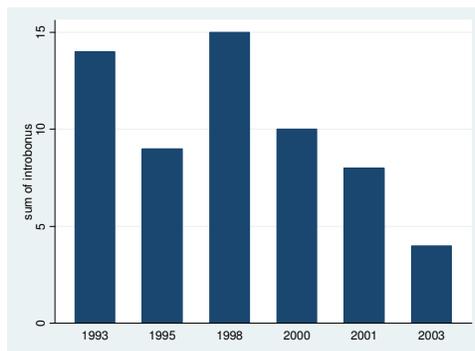
Expected bonus share in full wage variable was taken from a question Bonus share in full wage followed by question about concrete shares for specific years. Thus a conclusion was drawn that bonus share in the full wage question can be a proxy for a bonus share, average worker can orient to. We see that range of bonus shares in wage as well as its average value decreases over time from 36% to 23%, averaging to 28%. (Look Appendix 1)

Graph 8 Expected bonus share in full wage, time



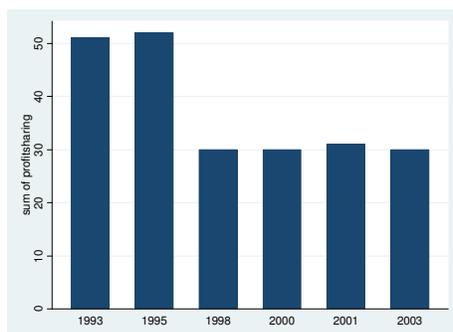
Introduction of performance related incentive pay scheme during the last year was received by finding difference between two dummy-variable questions: Operating performance related incentive pay scheme in current and previous years. Those enterprises that did not have it in the previous period and had it in current period were marked with ones while all others – with zeros. On average 10% of the enterprises introduced such schemes during each of time periods under consideration. Still there is a negative tendency towards bonus introduction, except for pike 1998.

Graph 9 Introduction of performance related incentive pay, time



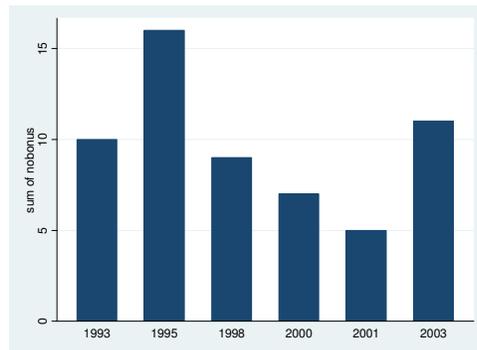
Profit-sharing system operated in the current period dummy variable is received from the same question. On average 40% of all enterprises used it each year, which seems strange. Though it was big in 1993 and in 1995, it decreased to 30 by 1998 and remains relatively at this level.

Graph 10 Operating profit sharing system, time



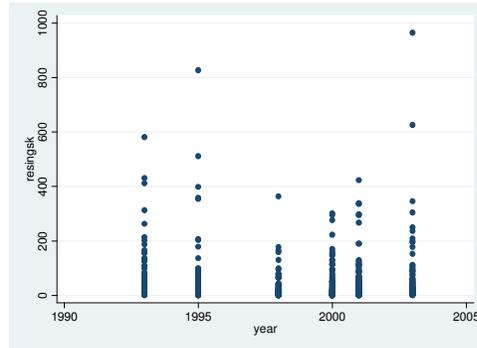
No performance related incentive pay scheme used, dummy variable was created out of the same question. On average 10% of all enterprises do not use any performance related incentive schemes with their employees. There is overall decreasing tendency visible, still spikes cannot bring to definite conclusion of how this variable is changing over time.

Graph 11 No performance related incentive pay scheme used, time



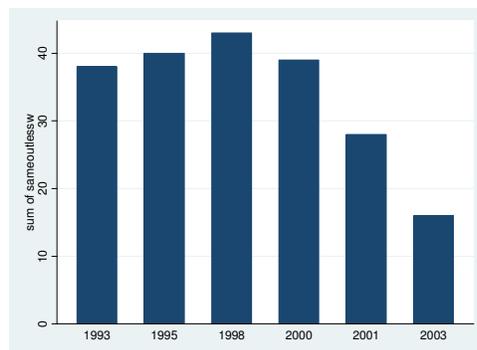
Resign skilled variable is used as a good proxy for turnover as skilled workers who resigned is a part of turnover that influences corporate performance most of all, as these workers are the most valuable part of the turnover. We see spikes in 1993 and 1995 which can be explained as mass movement of employees from state sector to more productive private sector. Then crisis 1998 and post crisis 2000 made employees think more about their financial security and stick to their existing jobs, followed by some relief during the next years. This variable varies from 0 to 964 and has the mean of 54 persons. For the model natural logarithm of this variable will be used.

Graph 12 Skilled workers that resigned over the last year, time



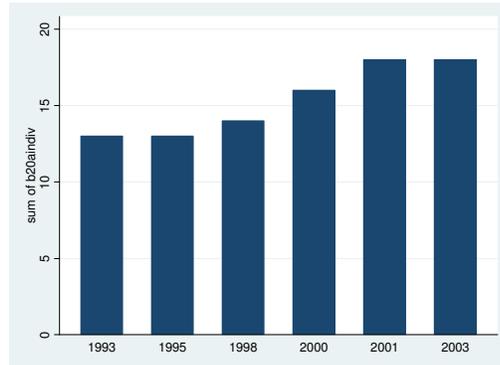
Personnel excess dummy is proxied by the variable which answers a question whether same output can be produced using less workers, if so there is some shirking personnel. Still this variable is doubtful as small personnel excess is a sign of personnel reserve availability, which is a good thing. On average 36% of enterprises had this problem, still the indicator has been decreasing since 1998.

Graph 13 Personnel excess, time



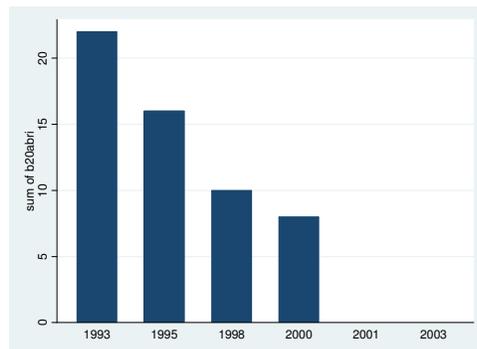
Individual level of wage determination is a dummy received from the same question, applied on average in 16% of enterprises and is constantly increasing over time.

Graph 14 Individual level of wage determination, time



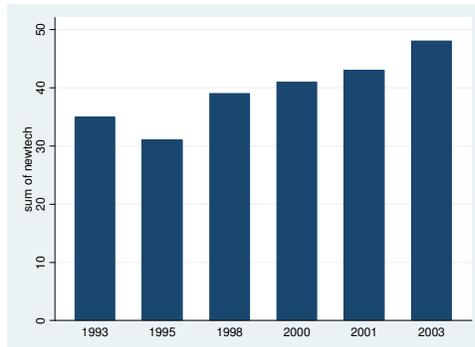
Brigade level of wage determination is a dummy received from the same question, applied on average in 10% of enterprises and is not used since 2000. There could be some problems with data, but even if so we see a strong tendency toward decrease.

Graph 15 Brigade level of wage determination, time



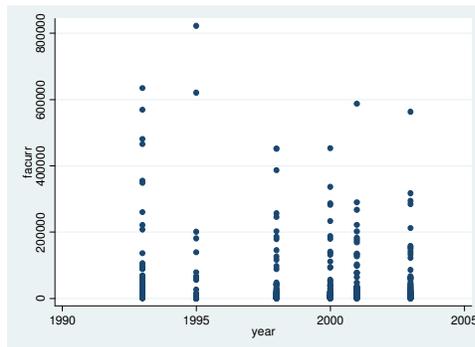
New technology introduced dummy variable taken from similar question. On average 43% of enterprises were introducing some new technology to their production process. The trend is increasing over time.

Graph 16 New technology introduced, time



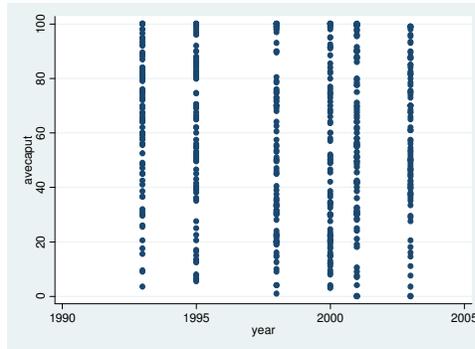
Fixed assets, variable in thousands UAH's taken from the same question in ULFS report. Variable ranges from 10 000 UAH to 821 940 000 UAH, averaging to 42 098 000 UAH. There is also some variance decrease visible over time. For the model natural logarithm of this variable will be used.

Graph 17 Fixed assets 1000 UAH, for the current period, time



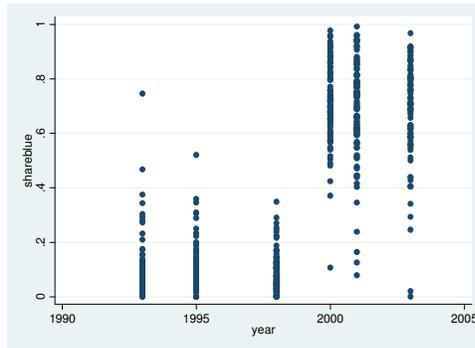
Capacity utilization, %. This variable was taken directly from the report and averages to 56%. It was distributed equally over the time periods under consideration.

Graph 18 Capacity utilization %, time



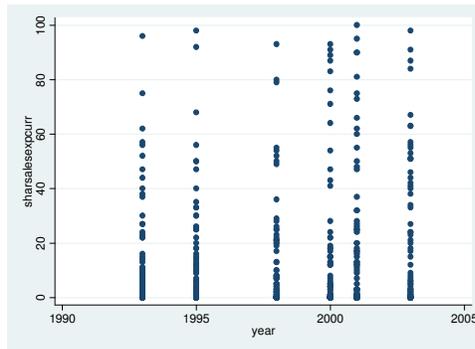
Share of blue-collar workers, %. There is an evident increase of blue-collar workers share since 2000, which could be due to different question formulation since 2000 or due to some personnel optimization with elimination of excessive administrative resource. On average 40% of questioned firms personnel are blue-collar workers.

Graph 19 Share of blue-collar workers %, time



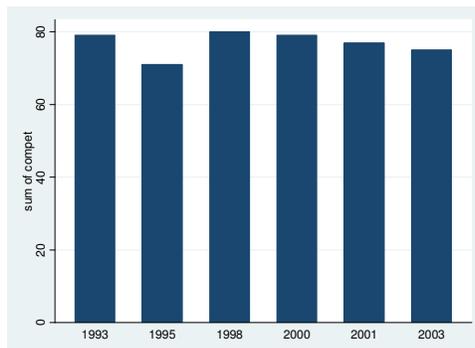
Share of exports in total sales, %. Variable is directly stated in the questionnaire. On average, 13% of sales are exported. With time average share of exports seems to grow.

Graph 20 Share of exports in total sales %, time



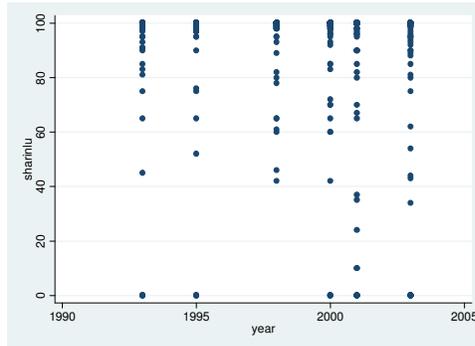
Competitive environment, direct dummy variable from a questionnaire, taking value 1 if environment is competitive of highly competitive. On average 83% of questioned firms found their business environment to be competitive. And it remains constant over time

Graph 21 Competitive environment, time



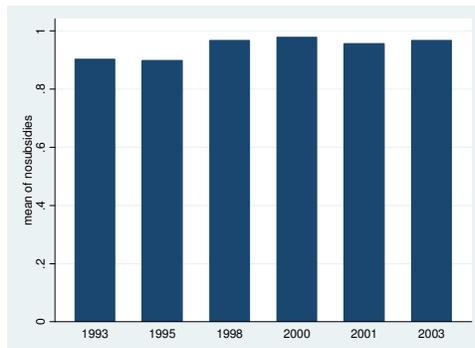
Share of workers-members of labor unions, %. Variable received directly from the questionnaire. Graph shows that Ukrainian business is highly unionized up to 90%.

Graph 22 Share of workers-members of labor unions %, time



No subsidies, variable created on the basis of similar question taking value 1 in enterprise is not a subject of subsidizing, among questioned – 94% on average are such. Slight increasing trend is visible.

Graph 23 No subsidies, time



EMPIRICAL FINDINGS

After the first, Pooled OLS model was run (Appendix 3), Data was tested for Heteroskedasticity with the help of Breusch-Pagan / Cook-Weisberg test for heteroskedasticity. Ho of this test is that that variance is constant, p-value if this test turned out to be really close to zero, thus we had to reject our hypothesis of homoscedasticity (Appendix 8). The positive moment of the model, is that correlations between independent variables are really low which is good as we can assume that we do not have multicollinearity. The results of Ramsey RESET Test gave p-value of over 30% (Appendix 8), which allows us not to reject Ho of this test that there is no omitted variables. As mentioned above, we assume there is not autocorrelation.

So the only crucial problem of this model is heteroskedasticity which can be reduced with the help of Fixed effect or Random effect model. In order to find out which of them gives a better fit, F-test, Breush-Pagan and Hausman specification tests were carried out. (Appendices 4, 8, 9)

F test gave the p-value 0.0003 wich allows to reject Ho hypothesis that all $u_i = 0$, thus Fixed effect model is better than Pooled OLS model. Breush-Pagan test showed p-value 0.009, bringing us to the conclusion that Random Effect gives us a better fit than Pooled OLS. Finally p-value under Hausman test is over 19%, thus we do not reject Ho that differences in coefficients B and b are not systematic, thus Random effect model is the most appropriate for this case. Random effect model (Appendix 5) has another advantage: it helps to take care of omitted variables that vary over cases while staying constant over time as well it helps to take control of omitted variables that vary over time while staying constants over Even though test did not show omitted variable problem, there

could still variables which should influence labor productivity but they were not included to this model due to unavailability. For example, average labor health at the enterprise, or average work experience.

Thus, after the Random effect model was run, the following results were received:

Table 2 Regression results

| | Coef. | Std. Err. | z | P>z | [95% Conf.Int.] | |
|---|-----------|-----------|-------|-------|-----------------|-----------|
| State owned | -0.389204 | 0.229989 | -1.69 | 0.091 | -0.839974 | 0.061566 |
| Expected bonus share in the full wage | 0.013036 | 0.004729 | 2.76 | 0.006 | 0.003766 | 0.022305 |
| Introduction of bonus system over last year | 0.388666 | 0.2312 | 1.68 | 0.093 | -0.064477 | 0.841809 |
| Fixed wage remuneration system | -0.580522 | 0.28027 | -2.07 | 0.038 | -1.12984 | -0.031203 |
| Brigade level wage determination | -0.678394 | 0.247339 | -2.74 | 0.006 | -1.16317 | -0.193618 |
| Logarithm of fixed assets | 0.194737 | 0.058563 | 3.33 | 0.001 | 0.079956 | 0.309518 |
| Capacity utilization | 0.006358 | 0.002931 | 2.17 | 0.03 | 0.000614 | 0.012102 |
| Share of personnel in labor union | -0.006322 | 0.003395 | -1.86 | 0.063 | -0.012975 | 0.000331 |
| Enterprise does not receive subsidies | 1.231751 | 0.392739 | 3.14 | 0.002 | 0.461996 | 2.001506 |

We see that labor productivity is determined by the fact of state ownership, expected bonus share in full wage, introduction of bonus system over the last year, fixed wage remuneration system, brigade level wage determination, logarithm of fixed assets, capacity utilization, share of personnel in labor union and inability of enterprise to get subsidies. These coefficients are significant at ten percent level.

We see that state owned enterprises are 38% less productive than privately owned ones. The sign is negative as it was expected. Every additional percent point of expected bonus share in full wage increases productivity by 1.3%. Sign is positive and it was expected to be such. Introduction of bonus system over the last year increases productivity in the next period by almost 39%. Again, sign of the relationship aligns with the expectations. This variable would be interesting to

study with a lag or two lags, unfortunately available data does not allow us to do so due to unbalanceness because data contains many gaps of different length. Enterprises not using performance related incentive schemes are 58% less productive than others. Sign is negative, as it was thought. Brigade level of remuneration decreases productivity by 67% comparing to firm level. Sign is negative, while it was expected to be positive. One of the possible explanations to this fact could be wide-spread free riding problem. An example of it could be group level evaluation of group projects among EERC students: if grade has to be distributed inside team, it is usually distributed equally, not depending on the performance of each group member – as a result each team member except for leader has incentive to free riding. Every 1% increase in fixed assets increase productivity by 0.19%, the sign is positive and it was expected to be positive. Every additional percentage point of capacity utilization increases labor productivity by 0.6%, while additional percentage point of employee participation in labor union decreases labor productivity by 0.6%. And finally, enterprises which do not receive subsidies are 123% more productive comparing to those who do. Still this huge coefficient could have appeared due to causality problem.

Thus we see, that monetary incentive performance related remuneration schemes are positively associated with labor productivity. Beside these variables property form, capital and some regulation factors also influence productivity.

CONCLUSIONS

This paper provides an analysis of how monetary incentive schemes influence labor productivity of 92 Ukrainian enterprises over six time periods from 1993 to 2003. Panel formed on the basis of Ukrainian Labor Force Survey or Questionnaire for the Survey of Labor Flexibility Policy at Industrial Enterprises was used for estimation. As a result, a clear evidence of positive effect of imposition of performance related monetary incentive schemes, as well as increasing a flexible performance related part of wage on labor productivity was detected. Moreover, enterprises which do not use performance related remuneration schemes are less productive, which coincides with classical principal-agent theory.

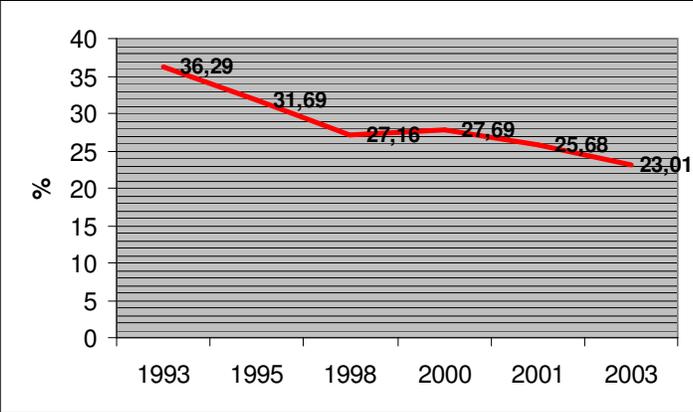
Mentioned earlier decreasing bonus share in the full wage over the last ten years, can be explained by other factors then crowding out. For instance, bonus system was traditional in Soviet Union, while in developed countries hourly rates used to be more widespread, thus now Ukraine approaches some market equilibrium level. The other possible explanation to this is that in conditions of economic instability employees prefer to have fixed part of their salary as big as possible, so firms decrease bonus share to make employees more loyal, sacrificing productivity.

BIBLIOGRAPHY

- Bartelsman, E.J., Doms, M.
Understanding Productivity: Lessons from Longitudinal Microdata, vol. 38, no. 3, pp. 569-594, Journal of Economic literature, 2000.
- Bayo-Mariones, A., Huerta-Arribas, E. *Organization Incentive Plans in Spanish Manufacturing Industry*, vol. 3, no. 2, pp. 128-142, Personnel Review, 2002.
- Bartelsman, E.J., Doms, M. (2000) “*Understanding Productivity: Lessons from Longitudinal Microdata*”, Journal of Economic literature, vol. 38, no. 3, pp. 569-594
- Buck, T., Filatotchev, I., Demina, N., Wright, M. *Insider Ownership, Human Resource Strategies and Performance in a Transition Economy*, I-20, Journal of International Business Studies, 2003.
- Coupe, T., *Labor Economic I, Lecture Notes*, pp. 16-21, 2006.
- Fehr, E., Falk, A. *Psychological Foundations of Incentives*, no. 507, IZA DP, 2002.
- Frey, B.S., Jegen, R. *Motivation Crowding Theory: A Survey of Empirical Evidence*, a working paper no. 49, vol. 15 (5), pp. 589-611, Journal of Economic Surveys, 2001.
- Ichniowski, C., Shaw, K. *Beyond Incentive Pay: Insiders' Estimates of the Value of Complementary Human Resource Management Practices*, vol. 17, no. 1, pp. 155–180, Journal of Economic Perspectives, 2003.
- Kruse, D. *Profit Sharing and Productivity: Microeconomic Evidence from the United States*, vol. 102, no. 410, 24-36, The Economic Journal, 2002.
- Lazear, E. *Performance Pay and Productivity*, vol. 90, no 5, Personnel Economics II, 2000.
- Leonard, J. *Carrots and Sticks: Pay, Supervision and Turnover*, vol. 5, no. 4, pt. 2, Journal of Labor Economics, 1987.
- McNabb, R., Whitfield, K. , *Varying Types of Performance Related Pay and Productivity Performance*, Cardiff University, Cardiff, CF10 3EU, UK., 2003
- Titmuss, R. M., *The Gift Relationship*, London: Allen and Unwin, 1970
- Чемеков, В. *Стратегические цели компании и мотивация персонала*, http://www.chelt.ru/2002/9-02/chemekov_9.html
- ULFS10 survey (1993-2003).

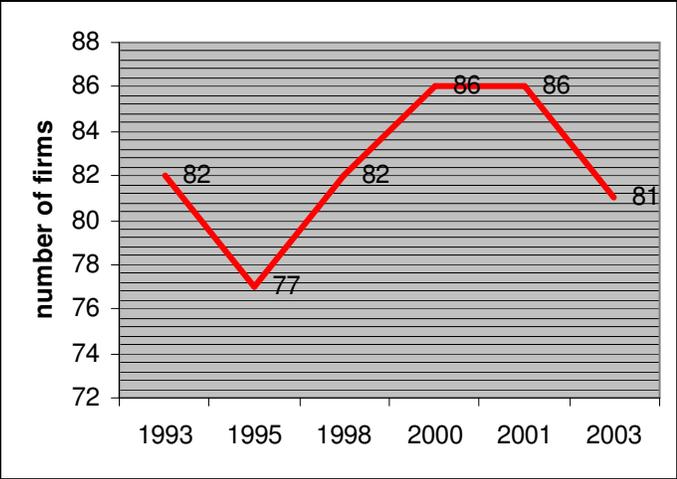
APPENDICES

Potential Bonus share in full wage, Ukraine 1993-2003



ULFS survey, 1993-2003

Firms, using bonuses, 1993-2003 (from the sample)



APPENDIX 3:

Pooled OLS output

| Source | SS | df | MS | Number of obs | 514 |
|----------|----------|------|---------|---------------|--------|
| Model | 1343.585 | 34.4 | 509027 | F(39, 474) | 14.4 |
| Residual | 1134.045 | 2.3 | 9249953 | Prob > F | 0 |
| Total | 2477.63 | 4.8 | 2968807 | R-squared | 0.5423 |
| | | | | Adj R-squared | 0.5046 |
| | | | | Root MSE | 1.5468 |

| Inprod | Coef. | Std. Err | t | P>t | [95% Conf Interval] |
|------------------------------|------------------|-----------------|--------------|--------------|----------------------------|
| v1993 | -2.060351 | 0.443001 | -4.65 | 0 | -2.93084 -1.189862 |
| v1995 | -2.333023 | 0.440385 | -5.3 | 0 | -3.198372 -1.467674 |
| v1998 | -0.276994 | 0.420512 | -0.66 | 0.51 | -1.103293 0.549305 |
| v2000 | -0.630859 | 0.256933 | -2.46 | 0.014 | -1.135727 -0.12599 |
| v2001 | -0.292538 | 0.23658 | -1.24 | 0.217 | -0.757413 0.172338 |
| v2003 | (dropped) | | | | |
| State owned | -0.355588 | 0.228106 | -1.56 | 0.12 | -0.803812 0.092636 |
| Share that belongs to | 0.001314 | 0.002453 | 0.54 | 0.592 | -0.003505 0.006133 |
| New organization | 0.191498 | 0.168363 | 1.14 | 0.256 | -0.139333 0.522328 |
| Logarithm of size | -0.111843 | 0.12916 | -0.87 | 0.387 | -0.365639 0.141954 |
| Expected bonus | 0.013818 | 0.004717 | 2.93 | 0.004 | 0.004549 0.023087 |
| Introduction of | 0.440973 | 0.234132 | 1.88 | 0.06 | -0.019092 0.901039 |
| Profitsharing system | 0.154604 | 0.161741 | 0.96 | 0.34 | -0.163214 0.472423 |
| Fixed wage | -0.556325 | 0.28294 | -1.97 | 0.05 | -1.112297 -0.000354 |
| Logarithm of skilled | -0.130436 | 0.088147 | -1.48 | 0.14 | -0.303643 0.042771 |
| Same output is | -0.079583 | 0.163929 | -0.49 | 0.628 | -0.4017 0.242534 |
| Individual level wage | 0.044222 | 0.203513 | 0.22 | 0.828 | -0.355677 0.444122 |
| Brigade level wage | -0.671188 | 0.247914 | -2.71 | 0.007 | -1.158334 -0.184041 |
| New technology | -0.027083 | 0.167195 | -0.16 | 0.871 | -0.355617 0.301452 |
| Logarithm of fixed | 0.207402 | 0.058014 | 3.58 | 0 | 0.093407 0.321398 |
| Capacity utilization | 0.006926 | 0.002837 | 2.44 | 0.015 | 0.001352 0.012501 |
| Share of blue collar | 0.691938 | 0.563002 | 1.23 | 0.22 | -0.414351 1.798227 |
| Share of sales exported | -0.001077 | 0.003587 | -0.3 | 0.764 | -0.008126 0.005971 |
| Competitive | -0.145235 | 0.204601 | -0.71 | 0.478 | -0.547271 0.256802 |
| Share of personnel in | -0.006922 | 0.003224 | -2.15 | 0.032 | -0.013257 -0.000586 |
| Enterprise does not | 1.237997 | 0.383045 | 3.23 | 0.001 | 0.48532 1.990674 |
| Construction | 0.790734 | 0.428756 | 1.84 | 0.066 | -0.051763 1.633231 |
| Food | 1.277193 | 0.322406 | 3.96 | 0 | 0.643672 1.910714 |
| Metallurgy | 1.369343 | 0.506449 | 2.7 | 0.007 | 0.374181 2.364505 |
| Chemical and Petroleum | 0.696716 | 0.397053 | 1.75 | 0.08 | -0.083486 1.476918 |
| Printing and Publishing | 0.420438 | 0.38309 | 1.1 | 0.273 | -0.332327 1.173203 |
| Light Industry | -0.101945 | 0.425536 | -0.24 | 0.811 | -0.938115 0.734225 |
| Energy | -0.726064 | 0.865924 | -0.84 | 0.402 | -2.427589 0.975461 |
| Machinebuilding | 0.207758 | 0.318186 | 0.65 | 0.514 | -0.417471 0.832987 |
| Kyiv Oblast | 0.554671 | 0.34057 | 1.63 | 0.104 | -0.114543 1.223885 |
| Kyiv City | 0.742945 | 0.331454 | 2.24 | 0.025 | 0.091644 1.394246 |
| Ternopil | 0.053962 | 1.609028 | 0.03 | 0.973 | -3.107748 3.215673 |
| Mykolayiv | 0.011172 | 0.323177 | 0.03 | 0.972 | -0.623864 0.646209 |
| Lviv | 0.46923 | 0.308234 | 1.52 | 0.129 | -0.136443 1.074904 |
| Kharkiv | 0.544123 | 0.296014 | 1.84 | 0.067 | -0.037538 1.125784 |
| Donetsk | (dropped) | | | | |

APPENDIX 4:

Fixed effect model output

Fixed-effects (within) regression

Group variable (i): id

R-sq: within = 0.5852

between = 0.1312

overall = 0.4088

Number of obs = 514

Number of groups = 92

Obs per group: min = 1

avg = 5.6

max = 6

F(33,389) = 16.63

Prob > F = 0.0000

corr(u₁, Xb) = -0.4036

| Logarithm of Productivity | Coefficient | Std. Err. | t | P>t | 95% Conf. | |
|--|------------------|-----------------|--------------|--------------|------------------|------------------|
| v1993 | -2.216092 | 0.484159 | -4.58 | 0 | -3.167989 | -1.264196 |
| v1995 | -2.824991 | 0.490009 | -5.77 | 0 | -3.788388 | -1.861595 |
| v1998 | -0.613674 | 0.455338 | -1.35 | 0.179 | -1.508905 | 0.281557 |
| v2000 | -0.62786 | 0.25559 | -2.46 | 0.014 | -1.130371 | -0.12535 |
| v2001 | -0.285476 | 0.223367 | -1.28 | 0.202 | -0.724633 | 0.153681 |
| State owned | -0.487946 | 0.263408 | -1.85 | 0.065 | -1.005828 | 0.029935 |
| Share that belongs to workers | -0.000757 | 0.00313 | -0.24 | 0.809 | -0.00691 | 0.005396 |
| New organization structure over | -0.042398 | 0.179533 | -0.24 | 0.813 | -0.395374 | 0.310578 |
| Logarithm of size | -0.10275 | 0.173328 | -0.59 | 0.554 | -0.443527 | 0.238027 |
| Expected bonus share in the | 0.010936 | 0.005321 | 2.06 | 0.041 | 0.000475 | 0.021397 |
| Introduction of bonus system | 0.161283 | 0.247418 | 0.65 | 0.515 | -0.32516 | 0.647726 |
| Profitsharing system | 0.183193 | 0.181538 | 1.01 | 0.314 | -0.173725 | 0.540111 |
| Fixed wage remuneration | -0.598004 | 0.305411 | -1.96 | 0.051 | -1.198466 | 0.002458 |
| Logarithm of skilled workers | -0.081433 | 0.097745 | -0.83 | 0.405 | -0.273607 | 0.110741 |
| Same output is possible with less | 0.145816 | 0.191278 | 0.76 | 0.446 | -0.230252 | 0.521885 |
| Individual level wage | 0.218635 | 0.244193 | 0.9 | 0.371 | -0.261468 | 0.698738 |
| Brigade level wage | -0.687509 | 0.27368 | -2.51 | 0.012 | -1.225585 | -0.149433 |
| New technology introduced over | -0.129483 | 0.189908 | -0.68 | 0.496 | -0.502857 | 0.243891 |
| Logarithm of fixed assets | 0.13772 | 0.066287 | 2.08 | 0.038 | 0.007394 | 0.268046 |
| Capacity utilization | 0.003196 | 0.003552 | 0.9 | 0.369 | -0.003788 | 0.010179 |
| Share of blue collar workers | 0.144386 | 0.626447 | 0.23 | 0.818 | -1.087259 | 1.376031 |
| Share of sales exported | -0.003262 | 0.004371 | -0.75 | 0.456 | -0.011855 | 0.005331 |
| Competitive environment | -0.0899 | 0.250693 | -0.36 | 0.72 | -0.582783 | 0.402984 |
| Share of personnel in labor union | -0.002632 | 0.004512 | -0.58 | 0.56 | -0.011503 | 0.006239 |
| Enterprise does not receive sub | 1.322526 | 0.471064 | 2.81 | 0.005 | 0.396376 | 2.248676 |
| Construction | 0.100673 | 0.723086 | 0.14 | 0.889 | -1.320972 | 1.522318 |
| Food | 1.232862 | 0.60836 | 2.03 | 0.043 | 0.036777 | 2.428946 |
| Metallurgy | 0.479052 | 1.161953 | 0.41 | 0.68 | -1.805442 | 2.763545 |
| Chemical and Petroleum | -0.364182 | 0.738882 | -0.49 | 0.622 | -1.816884 | 1.08852 |
| Printing and Publishing | -2.786456 | 1.506528 | -1.85 | 0.065 | -5.748411 | 0.1755 |
| Light Industry | -2.06621 | 0.756291 | -2.73 | 0.007 | -3.55314 | -0.579281 |
| Energy | -1.638637 | 1.127374 | -1.45 | 0.147 | -3.855145 | 0.577872 |
| Machinebuilding | -0.583825 | 0.621221 | -0.94 | 0.348 | -1.805196 | 0.637546 |
| Kyiv Oblast | (dropped) | | | | | |
| Kyiv City | (dropped) | | | | | |
| Ternopil | (dropped) | | | | | |
| Mykolayiv | (dropped) | | | | | |
| Lviv | (dropped) | | | | | |
| Kharkiv | (dropped) | | | | | |
| Donetsk | (dropped) | | | | | |
| Constant | 1.967468 | 1.220746 | 1.61 | 0.108 | -0.43262 | 4.367554 |

sigma_u

1.251354

sigma_e

1.443801

rho

0.428957 (fraction of variance due to u_i)

F test that all u_i=0:

F(91, 389) = 1.7

Prob > F = 0.0003

APPENDIX 5:

Random effect model output

Random-effects GLS regression

Group variable (i): id

Number of obs = 514

Number of groups = 92

R-sq: within = 0.5668

between = 0.4502

overall = 0.5406

Obs per group: min = 1

avg = 5.6

max = 6

Random effects u_i ~ Gaussian

Wald chi2(39) = 577.59

corr(u_i, X) = 0 (assumed)

Prob > chi2 = 0.0000

| | Coef. | Std. Err. | z | P>z | [95% Conf.Int.] | |
|--|------------------|-----------------|--------------|--------------|------------------|------------------|
| v1993 | -2.127361 | 0.43913 | -4.84 | 0 | -2.988039 | -1.266683 |
| v1995 | -2.46608 | 0.438758 | -5.62 | 0 | -3.32603 | -1.60613 |
| v1998 | -0.370213 | 0.41727 | -0.89 | 0.375 | -1.188046 | 0.44762 |
| v2000 | -0.607462 | 0.247704 | -2.45 | 0.014 | -1.092952 | -0.121972 |
| v2001 | -0.288686 | 0.225616 | -1.28 | 0.201 | -0.730885 | 0.153513 |
| State owned | -0.389204 | 0.229989 | -1.69 | 0.091 | -0.839974 | 0.061566 |
| Share that belongs to workers | 0.000923 | 0.002546 | 0.36 | 0.717 | -0.004067 | 0.005913 |
| New organization structure over last year | 0.131035 | 0.167009 | 0.78 | 0.433 | -0.196296 | 0.458367 |
| Logarithm of size | -0.125798 | 0.133897 | -0.94 | 0.347 | -0.388231 | 0.136636 |
| Expected bonus share in the full wage | 0.013036 | 0.004729 | 2.76 | 0.006 | 0.003766 | 0.022305 |
| Introduction of bonus system over last year | 0.388666 | 0.2312 | 1.68 | 0.093 | -0.064477 | 0.841809 |
| Profitsharing system | 0.160534 | 0.162356 | 0.99 | 0.323 | -0.157678 | 0.478746 |
| Fixed wage remuneration system | -0.580522 | 0.28027 | -2.07 | 0.038 | -1.12984 | -0.031203 |
| Logarithm of skilled workers resigned | -0.110411 | 0.08855 | -1.25 | 0.212 | -0.283966 | 0.063145 |
| Same output is possible with less workers | -0.046281 | 0.166347 | -0.28 | 0.781 | -0.372315 | 0.279753 |
| Individual level wage determination | 0.074595 | 0.20729 | 0.36 | 0.719 | -0.331685 | 0.480875 |
| Brigade level wage determination | -0.678394 | 0.247339 | -2.74 | 0.006 | -1.16317 | -0.193618 |
| New technology introduced over last year | -0.050376 | 0.169285 | -0.3 | 0.766 | -0.382168 | 0.281417 |
| Logarithm of fixed assets | 0.194737 | 0.058563 | 3.33 | 0.001 | 0.079956 | 0.309518 |
| Capacity utilization | 0.006358 | 0.002931 | 2.17 | 0.03 | 0.000614 | 0.012102 |
| Share of blue collar workers | 0.492753 | 0.565633 | 0.87 | 0.384 | -0.615867 | 1.601373 |
| Share of sales exported | -0.001156 | 0.00368 | -0.31 | 0.753 | -0.008367 | 0.006056 |
| Competitive environment | -0.118673 | 0.211699 | -0.56 | 0.575 | -0.533596 | 0.296249 |
| Share of personnel in labor union | -0.006322 | 0.003395 | -1.86 | 0.063 | -0.012975 | 0.000331 |
| Enterprise does not receive subsidies | 1.231751 | 0.392739 | 3.14 | 0.002 | 0.461996 | 2.001506 |
| Construction | 0.753566 | 0.469362 | 1.61 | 0.108 | -0.166366 | 1.673498 |
| Food | 1.279696 | 0.35821 | 3.57 | 0 | 0.577618 | 1.981774 |
| Metallurgy | 1.274592 | 0.573336 | 2.22 | 0.026 | 0.150874 | 2.398311 |
| Chemical and Petroleum | 0.569069 | 0.435253 | 1.31 | 0.191 | -0.28401 | 1.422149 |
| Printing and Publishing | 0.29485 | 0.439432 | 0.67 | 0.502 | -0.56642 | 1.15612 |
| Light Industry | -0.398312 | 0.46831 | -0.85 | 0.395 | -1.316183 | 0.519559 |
| Energy | -0.746288 | 0.893797 | -0.83 | 0.404 | -2.498099 | 1.005523 |
| Machinebuilding | 0.141742 | 0.355501 | 0.4 | 0.69 | -0.555027 | 0.838512 |
| Kyiv Oblast | 0.455828 | 0.396812 | 1.15 | 0.251 | -0.321909 | 1.233564 |
| Kyiv City | 0.672011 | 0.389699 | 1.72 | 0.085 | -0.091786 | 1.435808 |
| Ternopil | -0.094562 | 1.623719 | -0.06 | 0.954 | -3.276992 | 3.087868 |
| Mykolayiv | -0.1126 | 0.374964 | -0.3 | 0.764 | -0.847517 | 0.622317 |
| Lviv | 0.427783 | 0.363955 | 1.18 | 0.24 | -0.285557 | 1.141123 |
| Kharkiv | 0.461782 | 0.347187 | 1.33 | 0.183 | -0.218692 | 1.142255 |
| Constant | 0.400289 | 0.99957 | 0.4 | 0.689 | -1.558832 | 2.359409 |

sigma_u

0.48051

sigma_e

1.443801

rho

0.099717 (fraction of variance due u_i)

APPENDIX 6

| Variable/Correlation | State owned | Share that belongs to workers | New organization structure over last year | Logarithm of size | Expected bonus share in the full wage | Introduction of bonus system over last year | Profitsharing system | Fixed wage remuneration system | Logarithm of skilled workers resigned | Same output is possible with less workers | Individual level wage determination | Brigade level wage determination | New technology introduced over last year | Logarithm of fixed assets | Capacity utilization |
|---|-------------|-------------------------------|---|-------------------|---------------------------------------|---|----------------------|--------------------------------|---------------------------------------|---|-------------------------------------|----------------------------------|--|---------------------------|----------------------|
| State owned | 1.00 | | | | | | | | | | | | | | |
| Share that belongs to workers | -0.3391 | 1.00 | | | | | | | | | | | | | |
| New organization structure over last year | -0.1368 | -0.0102 | 1.00 | | | | | | | | | | | | |
| Logarithm of size | 0.1468 | -0.0571 | 0.2301 | 1.00 | | | | | | | | | | | |
| Expected bonus share in the full wage | 0.2312 | -0.1174 | -0.006 | 0.1663 | 1.00 | | | | | | | | | | |
| Introduction of bonus system over last year | -0.0272 | 0.0426 | -0.042 | 0.0131 | -0.1080 | 1.00 | | | | | | | | | |
| Profitsharing system | -0.0148 | 0.1470 | 0.0200 | 0.0830 | 0.2037 | 0.0522 | 1.00 | | | | | | | | |
| Fixed wage remuneration system | -0.0648 | 0.1024 | -0.055 | -0.1659 | -0.4791 | -0.0288 | -0.1290 | 1.00 | | | | | | | |
| Logarithm of skilled workers resigned | 0.0857 | -0.0426 | 0.1580 | 0.7566 | 0.0089 | -0.0186 | -0.0233 | -0.0296 | 1.00 | | | | | | |
| Same output is possible with less workers | 0.0427 | 0.0214 | 0.1187 | 0.1298 | 0.0487 | 0.0254 | 0.0437 | -0.0532 | -0.0290 | 1.00 | | | | | |
| Individual level wage determination | -0.0093 | -0.0132 | -0.035 | -0.0531 | -0.1619 | -0.0346 | -0.116 | 0.0604 | 0.0117 | 0.0760 | 1.00 | | | | |
| Brigade level wage determination | 0.0845 | 0.0333 | 0.0145 | 0.0334 | 0.0587 | 0.0299 | -0.0332 | -0.0269 | 0.0016 | 0.0305 | -0.1520 | 1.00 | | | |
| New technology introduced over last year | -0.1007 | 0.0256 | 0.3994 | 0.2106 | 0.1603 | -0.0183 | 0.1464 | -0.0936 | 0.1186 | 0.0580 | -0.0453 | -0.0516 | 1.00 | | |
| Logarithm of fixed assets | 0.0712 | -0.1817 | 0.2299 | 0.6422 | 0.1375 | 0.0595 | -0.0473 | -0.1831 | 0.4832 | 0.0522 | -0.0854 | -0.0339 | 0.2390 | 1.00 | |
| Capacity utilization | 0.0667 | 0.0968 | 0.0332 | 0.0703 | 0.1415 | 0.0464 | 0.1898 | -0.0303 | 0.0680 | -0.2473 | -0.1892 | 0.0409 | 0.1805 | 0.0683 | 1.00 |

APPENDIX 7:

Model testing: Correlations with residuals

| Correlation | resid |
|---|-------|
| Logarithm of productivity | 0.32 |
| v1993 | -0 |
| v1995 | 0.01 |
| v1998 | -0.01 |
| v2000 | -0.01 |
| v2001 | 0.01 |
| v2003 | 0 |
| State owned | 0.01 |
| Share that belongs to workers | 0.04 |
| New organization structure over last year | 0.12 |
| Logarithm of size | 0.04 |
| Expected bonus share in the full wage | -0.01 |
| Introduction of bonus system over last year | 0.04 |
| Profitssharing system | 0.02 |
| Fixed wage remuneration system | 0.02 |
| Logarithm of skilled workers resigned | 0.03 |
| Same output is possible with less workers | -0.07 |
| Individual level wage determination | -0.02 |
| Brigade level wage determination | 0 |
| New technology introduced over last year | 0.09 |
| Logarithm of fixed assets | 0.03 |
| Capacity utilization | 0.1 |
| Share of blue collar workers | 0.03 |
| Share of sales exported | 0.07 |
| Competitive environment | -0 |
| Share of personnel in labor union | -0.04 |
| Enterprise does not receive subsidies | 0.01 |
| Construction | -0.03 |
| Food | 0.1 |
| Metallurgy | -0 |
| Chemical and Petroleum | 0.04 |
| Printing and Publishing | 0.02 |
| Light Industry | 0.18 |
| Energy | 0.01 |
| Machinebuilding | 0.02 |
| Kyiv Oblast | -0.01 |
| Kyiv City | -0.01 |
| Ternopil | -0 |
| Mykolayiv | 0.02 |
| Lviv | 0 |
| Kharkiv | 0.01 |
| Donetsk | -0 |

Model Testing

Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test

Ho: Constant variance

Variables: fitted values of lnprod

chi2(1) = 71.14

Prob > chi2 = 0.0000

Omitted variables

Ramsey RESET test using powers of the fitted values of lnprod

Ho: model has no omitted variables

F(3, 471) = 1.06

Prob > F = 0.3663

Random effect vs Pooled OLS

Breusch-Pagan Test

$$\ln\text{prod}[\text{id},t] = Xb + u[\text{id}] + e[\text{id},t]$$

Estimated results:

| | Var | sd = sqrt(Var) |
|-----------|-----------|----------------|
| Logarithm | 4.829688 | 2.197655 |
| e | 2.084561 | 1.443801 |
| u | 0.2308902 | 0.4805104 |

Test: Var(u) = 0

chi2(1) = 6.82

Prob > chi2 = 0.0090

APPENDIX 9:

Model Testing Hausman test: Fixed effect vs. Random Effect

| Hausman test | Coefficients | | | |
|---|--------------|------------|------------|----------------|
| | (b) | (B) | (b-B) | sqrt (diag(V_b |
| | fixed | random | Difference | S.E. |
| v1993 | -2.216092 | -2.127361 | -0.0887316 | 0.2039008 |
| v1995 | -2.824991 | -2.46608 | -0.3589116 | 0.2181738 |
| v1998 | -0.6136741 | -0.370213 | -0.243461 | 0.1822592 |
| v2000 | -0.6278602 | -0.607462 | -0.0203982 | 0.0630015 |
| v2001 | -0.2854761 | -0.288686 | 0.0032099 | |
| State owned | -0.4879464 | -0.389204 | -0.0987424 | 0.1284093 |
| Share that belongs to workers | -0.0007566 | 0.0009228 | -0.0016794 | 0.0018198 |
| New organization structure over last year | -0.0423981 | 0.1310354 | -0.1734335 | 0.0658788 |
| Logarithm of size | -0.10275 | -0.1257976 | 0.0230476 | 0.1100642 |
| Expected bonus share in the full wage | 0.0109359 | 0.0130355 | -0.0020996 | 0.0024381 |
| Introduction of bonus system over last year | 0.1612827 | 0.3886659 | -0.2273832 | 0.088103 |
| Profitsharing system | 0.1831929 | 0.1605336 | 0.0226593 | 0.0812189 |
| Fixed wage remuneration system | -0.5980042 | -0.5805215 | -0.0174827 | 0.1213447 |
| Logarithm of skilled workers resigned | -0.081433 | -0.1104107 | 0.0289777 | 0.0413866 |
| Same output is possible with less workers | 0.1458163 | -0.0462806 | 0.1920969 | 0.094425 |
| Individual level wage determination | 0.2186349 | 0.0745949 | 0.14404 | 0.1290784 |
| Brigade level wage determination | -0.6875089 | -0.6783943 | -0.0091146 | 0.1171487 |
| New technology introduced over last year | -0.129483 | -0.0503755 | -0.0791075 | 0.0860669 |
| Logarithm of fixed assets | 0.1377203 | 0.194737 | -0.0570168 | 0.0310544 |
| Capacity utilization | 0.0031958 | 0.006358 | -0.0031622 | 0.0020066 |
| Share of blue collar workers | 0.1443862 | 0.4927532 | -0.3483671 | 0.2692487 |
| Share of sales exported | -0.0032622 | -0.0011557 | -0.0021065 | 0.0023585 |
| Competitive environment | -0.0898995 | -0.1186734 | 0.0287739 | 0.134278 |
| Share of personnel in labor union | -0.0026321 | -0.006322 | 0.0036899 | 0.0029726 |
| Enterprise does not receive subsidies | 1.322526 | 1.231751 | 0.0907754 | 0.2601101 |
| Construction | 0.1006727 | 0.7535659 | -0.6528932 | 0.5500475 |
| Food | 1.232862 | 1.279696 | -0.0468343 | 0.4917186 |
| Metallurgy | 0.4790515 | 1.274592 | -0.7955406 | 1.010653 |
| Chemical and Petroleum | -0.3641818 | 0.5690694 | -0.9332513 | 0.597078 |
| Printing and Publishing | -2.786456 | 0.2948502 | -3.081306 | 1.441016 |
| Light Industry | -2.06621 | -0.3983124 | -1.667898 | 0.5938536 |
| Energy | -1.638637 | -0.746288 | -0.8923488 | 0.6870942 |
| Machinebuilding | -0.5838251 | 0.1417424 | -0.7255675 | 0.5094456 |

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\chi^2(34) = (b-B)'[(V_b-V_B)^{-1}](b-B) = 39.88$$

$$\text{Prob} > \chi^2 = 0.1906$$

(V_b-V_B is not positive definite)

Scheme of possible payoffs

